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SUBJECT: Forwards SG tube inspections prior to startup rept. Attachment 1 contains Category C-3 rept,required by TS 4.4.5.5(c),including follow-up investigations & subsequent repairs formed.

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AEP:NRC:1166I

Donald C. Cook Nuclear Plant Unit 1
Docket No. 50-315
License No. DPR-58
STEAM GENERATOR TUBE INSPECTIONS
PRIOR TO STARTUP REPORT

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Attn: W. T. Russell

April 18, 1994

Dear Mr. Russell:

Pursuant to the requirements of Donald C. Cook Nuclear Plant Technical Specifications 4.4.5.5(c) and (e), this letter transmits the required "prior to restart" report on the results of our eddy current inspection and subsequent repairs performed on the steam generator tubes during the 1994 Unit 1 Refueling Outage.

Attachment 1 contains the Category C-3 report, required by T/S 4.4.5.5(c), including follow-up investigations and subsequent repairs performed. Attachment 2 contains the steamline break leakage analysis required by T/S 4.4.5.5(e) and provides the evaluation of the probability of tube burst during a steamline break committed to in our letter AEP:NRC:1166M, dated February 14, 1994.

Sincerely,

W. J. Smith

for E. E. Fitzpatrick
Vice President

Attachments

dr

cc: A. A. Blind
G. Charnoff
J. B. Martin - Region III
NFEM Section Chief
NRC Resident Inspector
J. R. Padgett

A001

ATTACHMENT 1 TO AEP:NRC:1166I

CATEGORY C-3 REPORT

CATEGORY C-3 INVESTIGATION

The results of the Cook Nuclear Plant Unit 1 refueling outage eddy current inspections for both bobbin coil (BC) and rotating pancake coil (RPC) tube sample programs were provided to the NRC in our letter AEP:NRC:1166O, dated March 30, 1994. The inspection resulted in a Category C-3 classification, per Technical Specification 4.4.5.5.

The principal reason for the C-3 classification was the number of defects identified at the hot leg top-of-tubesheet region by RPC inspection. Outside diameter stress corrosion cracking (ODSCC) indications at the hot leg top of tubesheet region has historically been an area of concern in the Unit 1 steam generators. Review of the data shows a majority of the indications, approximately 88%, to be below the top of tubesheet in a range from a few tenths of an inch to 2.25 inches. The remaining indications were at or slightly above the top of tubesheet in a range of 0.0 inches to 0.7 inches. As a result of this RPC inspection, 237 tubes were plugged (as noted in Table 1 of Attachment 2 of AEP:NRC:1166O).

To assist in determining the trend in ODSCC, the 1992 RPC data were reviewed using the 1994 analysis guidelines. This review identified that approximately 40% of the indications were new and that the balance were present during the 1992 inspection. The RPC voltage range for the majority of the indications was less than 0.5 volts. In general, the indications typically exhibited only slight changes in depth and/or volume. The data collection during the 1994 inspection had a higher signal to noise ratio and a higher rotating probe speed than in 1992, making the indications more discernible. This, coupled with more experienced analysts and improved analysis guidelines and training assisted in the identification of these low voltage indications during the 1994 inspection. Although it is apparent from the 1994 data that tube corrosion has not completely stopped, it is continuing at a slow, manageable rate.

In an effort to combat the ODSCC at the top of tubesheet, a number of additional remedial measures were employed this refueling outage. Two new processes were added to the steam generator secondary side sludge removal operations: sludge removal with the Consolidated Edison Combined Inspection and Lancing System (CECIL) and Pressure Pulse Cleaning (PPC). CECIL provides the capability to perform sludge removal deep in the tube bundle, using a high pressure spray at observed areas of hard sludge buildup. PPC provides the ability to forcibly surge water through the tube support plate openings and also creates turbulence at the top of tubesheet which aids in the agitation and soaking of crevice regions. This is in addition to the primary objective of PPC, which is removal of sludge deposits throughout the steam generator. Remedial measures which will remain in effect include reactor coolant system reduced pressure and temperature operation, on-line boric acid addition, boric acid tubesheet crevice flushing during startup, tubesheet sludge removal, and improved secondary side chemistry.

The 1994 eddy current inspection results will be reviewed in further detail in the following months, along with other available industry experience. This will be done to develop an overall assessment of steam generator tube integrity and to assess the need for any changes to the remedial measures now in place, as well as to aid in planning for future tube inspections.

ATTACHMENT 2 TO AEP:NRC:1166I

STEAMLINE BREAK LEAKAGE ANALYSIS AND PROBABILITY OF TUBE BURST EVALUATION

D. C. Cook Unit 1 Interim Plugging Criteria
Letter Report

This report provides a summary and conclusions of the leak rate and burst calculations performed for the D. C. Cook Unit 1 interim plugging criteria.

SLB Leak Rate Calculation Results

Table 1 provides a summary of the D. C. Cook 1 projected EOC-14 leak rate results. SLB leak rates were calculated for a total of twelve cases, the combination of six probability-of-leak correlations and two leak rate calculation methodologies. The two leak rate calculations are those in draft NUREG-1477 and a leak rate versus voltage correlation (regression analysis). This meets the requirements of the Cook-1 IPC SER requirements. The NRC SER also specifies that the analyses are to be based on a leakage and burst database that excludes outliers only on the basis of bad data. This guidance is followed for the SER required analyses, although the NRC SER database differs from the EPRI database in the treatment of outliers. In some cases, such as the POL correlations, the differences between the NRC and EPRI databases are negligible. Consistent with the NRC guidance of the February 8, 1994, NRC/Industry meeting, criteria were developed and used to delete non-applicable data. The SLB leak rates are correlated with voltage within the statistical confidence guidelines presented at that meeting. The leak rates for the APC leak rate correlation methodology are on the order of 100 times lower than those obtained by the NUREG calculation, which does not consider the correlation.

Leakage calculations were based on the calculated EOC-14 voltage distribution determined by applying the Cycle 13 growth distribution to the BOC-14 indications, using Monte Carlo techniques. This was performed for the more limiting steam generator, SG-14. Table 2 shows the groupings of indications utilized to determine the growth distribution. Figure 1 provides the BOC-14 and EOC-14 voltage distribution results.

Burst Probability Calculation Results

The probability of tube burst under steam line break pressure differential was calculated utilizing the EPRI recommended database and the NRC provisionally recommended database (which is pending review of EPRI proposals.) The differences in the databases are primarily associated with EPRI recommendations to exclude high burst pressure outliers (D. C. Cook-1 and Kewaunee) from the burst correlation. The probability of tube burst at EOC-14 with the EPRI recommended database is 3.9×10^{-5}, while the NRC recommended database provides a probability of burst value of 1.6×10^{-3}. Both values are less than the allowable SLB probability of burst value 2.5×10^{-2}, and therefore demonstrate acceptable results.

Table 1

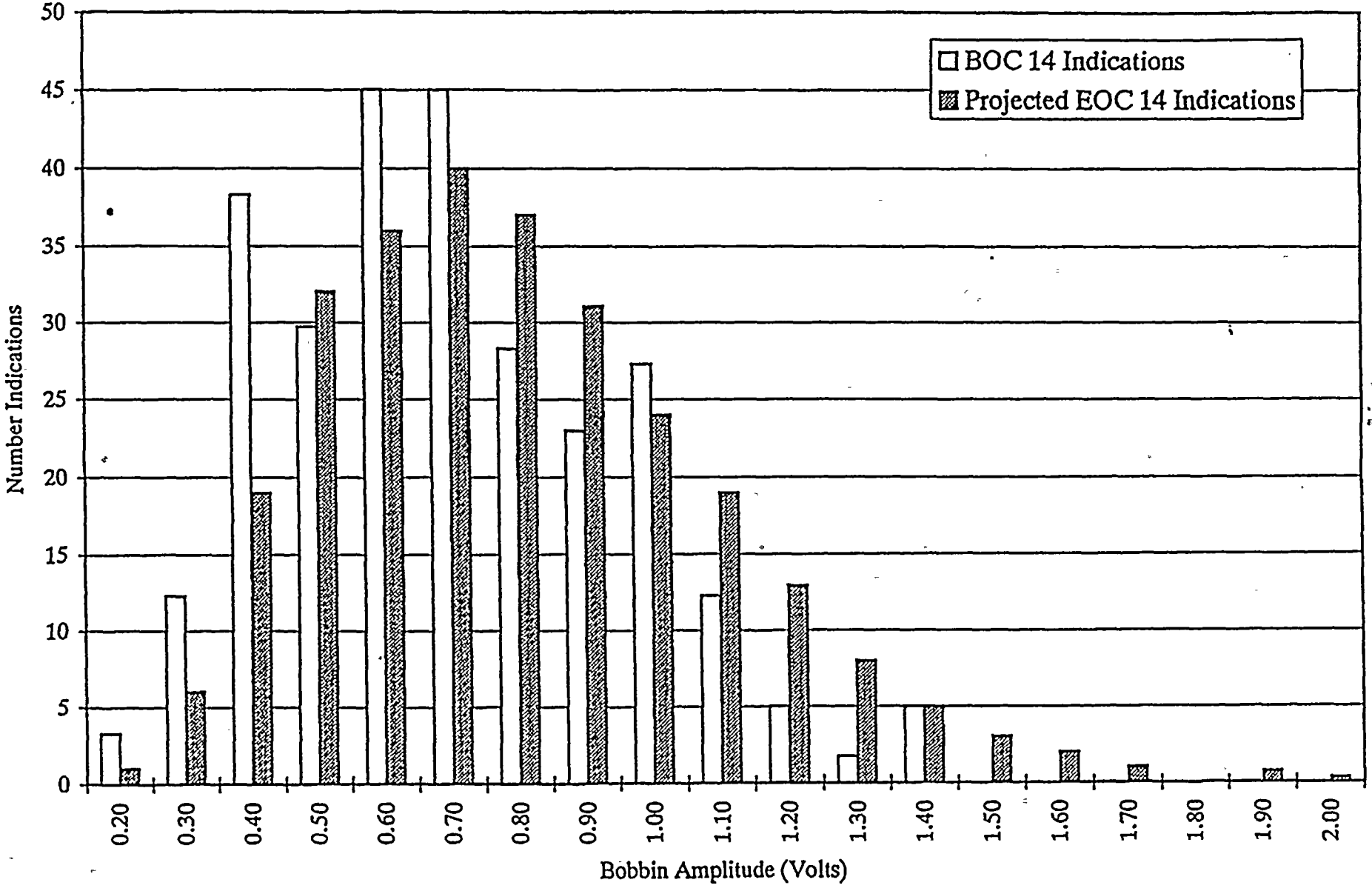
SG-14: Summary of Cook-1 EOC-14 SLB Leak Rate Analysis Results

	SLB Leak Rates (gpm)	
Leakage EOC Voltage Distribution	Draft NUREG-1477 Method	APC Leak Rate Correlation
Bobbin with POD Adjustment		
- Log logistic POL	0.110	0.001
- Logistic POL	0.607	0.004
- Log normal POL	0.045	0.001
- Normal POL	0.452	0.003
- Log Cauchy POL	0.853	0.005
- Cauchy POL	1.360	0.008

Table 2: Cook 1, EOC 13, Comparison of PIs Found at TSPs, Confirmed by RPC, and Indications Repaired

	Steam Generator 1				Steam Generator 2				Steam Generator 3				Steam Generator 4				All Steam Generators			
Volts	No. of Bobbin Indications	No. of Indications Examined	No. of Indications Confirmed	No. of Indications Repaired	No. of Bobbin Indications	No. of Indications Examined	No. of Indications Confirmed	No. of Indications Repaired	No. of Bobbin Indications	No. of Indications Examined	No. of Indications Confirmed	No. of Indications Repaired	No. of Bobbin Indications	No. of Indications Examined	No. of Indications Confirmed	No. of Indications Repaired	No. of Bobbin Indications	No. of Indications Examined	No. of Indications Confirmed	No. of Indications Repaired
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.2	2	0	0	0	3	0	0	0	1	0	0	0	2	0	0	0	8	0	0	0
0.3	4	0	0	0	3	0	0	0	5	0	0	1	8	0	0	1	20	0	0	2
0.4	22	0	0	1	12	0	0	1	11	0	0	0	23	0	0	1	68	0	0	3
0.5	24	0	0	1	21	0	0	1	13	0	0	0	19	1	0	2	77	1	0	4
0.6	28	0	0	2	14	0	0	0	13	0	0	0	27	0	0	0	82	0	0	2
0.7	23	0	0	1	11	0	0	0	7	0	0	0	27	0	0	0	68	0	0	1
0.8	20	1	0	0	13	0	0	0	13	0	0	1	17	2	0	0	63	3	0	1
0.9	16	0	0	2	9	0	0	0	7	0	0	0	15	13	1	2	47	13	1	4
1.0	7	0	0	1	9	0	0	0	5	0	0	0	17	17	5	1	38	17	5	2
1.1	6	6	2	0	1	1	0	1	2	2	1	0	8	8	0	1	17	17	3	2
1.2	2	2	1	0	3	3	2	0	5	5	3	0	3	3	2	0	13	13	8	0
1.3	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2	2	1	0
1.4	0	0	0	0	1	1	0	0	1	1	1	0	3	3	1	0	5	5	2	0
1.5	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0
1.6	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	0	3	3	3	1
1.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.8	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	2	2	1	0
Total	156	11	4	9	103	8	4	3	84	9	5	2	171	49	11	8	514	77	24	22
Total > 1V	10	10	4	1	8	8	4	1	9	9	5	0	16	16	5	1	43	43	18	3

Figure 1: D. C. Cook 1, SG 4, Distribution of TSP Indications
PoD Adjusted BOC Indications Projected to the End of Cycle 14



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